



# FARMING WITH HIGH RESIDUE

Box

## FOR PROFIT AND

## EROSION CONTROL



Crop Residue Management ...

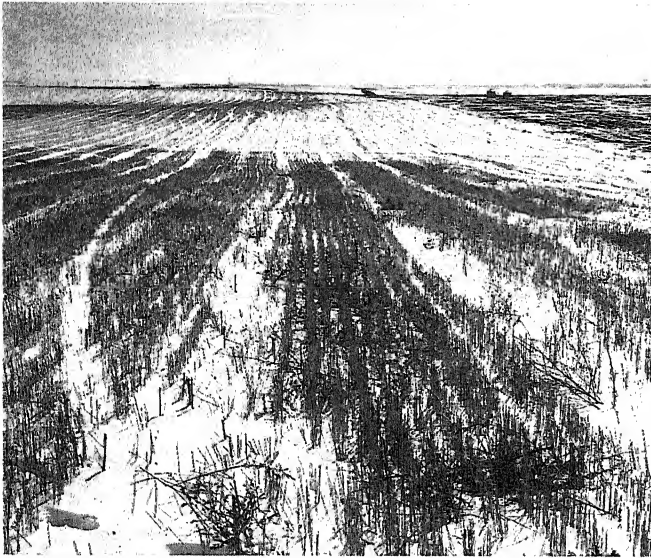
It's a good way

to farm.



USDA Soil Conservation Service  
Bismarck, North Dakota

## Crop residue management keeps cover on the soil.



Crop residue will:

- Increase profits
- Control erosion
- Catch snow for additional moisture
- Reduce evaporation loss when greater than 2,000 pounds per acre
- Improve infiltration of water
- Protect seedlings from abrasive forces of wind
- Trap snow to protect winter wheat from winterkill
- Reduce surface runoff and soil loss
- Will maintain or improve organic matter content
- Provide food and cover for wildlife
- Retain precipitation

Crop residue is free ... and in place. It's delivered at harvest time, and is easily managed.

### HOW MUCH RESIDUE IS NEEDED?

The amount of crop residue needed to protect soil from erosion depends on the slope length, distance across and size of the field, and soil texture.

Water erosion can be a problem on gently to steeply sloping land. If water erosion is a concern, surface residue needs to be present, especially after planting.

Wind erosion can occur on any soil but some soils are more susceptible than others. Sandy soils are the most likely to blow. Clayey soils, especially after over-winter break down, can also blow easily.

The amount of residue is based on:

- Residue levels after harvest
- Effects of tillage or spray operations
- Moisture conservation and yield goals.

This publication discusses how to use crop residue to increase profits, help control wind and water erosion, and improve the soil resource. For more information, contact your local soil conservation district or county Extension Service office.

### RESIDUE MANAGEMENT

Crop residue is an important and manageable resource for erosion control, moisture conservation, and improvement of soil tilth and organic matter content. Crop residue management starts at harvest time when straw and chaff are evenly spread over the width harvested.

Handling large amounts of residue is a challenge, but the rewards are apparent. The immediate benefits of crop residue management for erosion control and snow trapping are augmented by the long-term improvement of crop yields, soil structure, and organic matter content.

Only when straw can not be spread effectively should a portion be removed from the field. The idea is not only to maintain a complete cover for moisture conservation, but also to enhance the organic matter content.

Upright residue protects the soil from wind erosion and traps snow. It decomposes slowly because of limited contact with the soil. The portion of harvested crop residue that passes through the combine should be spread evenly across the soil surface to enhance decomposition.



*Crop residue management starts here*

## STRAW AND CHAFF SPREADING

Most combines today spread straw 15 to 25 feet, usually less than the width of the swather or combine cut. Producers should be concerned with spreading straw and chaff evenly the entire width of the swath. Chaff spreading is accomplished by adding a spreader below and behind the sieves. Spreaders are either mechanically or hydraulically driven. Most spreaders move the chaff mechanically using paddles; others use air. Some spreaders must be used in conjunction with a deflector to move chaff from sieves to spreader.

An efficient chaff spreader will prevent a 2 or 3 inch thick residue cover behind the combine. In a year with particularly heavy straw, harrowing may be necessary after harvest. However, it is NOT POSSIBLE to spread chaff effectively by harrowing.

If chaff is not spread, it can lead to problems the next season. Problems include poor emergence, weak plants that are more susceptible to disease, extra weed and volunteer crop growth, and nitrogen deficiency in the chaff row.

In summary, factors to look for in a chaff spreader are:

- low power requirement,
- spread uniformity, and
- accessibility for adjustments and for cleaning.

## MOISTURE MANAGEMENT

With any Great Plains crop, the most significant yield limiting growth factor is moisture. Snow, trapped by stubble, is a guaranteed source of readily available soil moisture for the next crop. Holding extra snow on a field is one of the benefits of upright crop residue.

There are other positive impacts as well. Crop residue reduces runoff. This helps control erosion, and holds water on the field to soak into the soil. Precipitation tends to stay where it falls. Reduced snow drifting and water movement means that every part of a field, including slopes, reaps the benefit. Once the water has soaked into the soil, the residue on the surface reduces water loss from evaporation.

## HOW MUCH RESIDUE CAN BE EXPECTED?

The amount of residue actually produced by a crop is influenced by the growing season, crop species, variety, fertilizer program, and other factors. Table 1 gives the average residue produced by common crops.

There are two methods to determine the amount of residue actually present. One is to gather, weigh and convert the residue to pounds per acre. The other is to determine the percent of the soil surface covered with crop residue.

The residue weighing method is difficult and time consuming. It's much easier and more efficient to measure residue on the basis of percent cover.

TABLE 1

Crop	Unit	Pounds Residue Per Unit
Winter wheat, rye	bu	120
Spring wheat, durum	bu	100
Barley, flax, millet	bu	80
Corn, grain	bu	60-90
Grain sorghum	bu	60
Oats, soybean	bu	50
Safflower, mustard, rapeseed, buckwheat	lb	1.5
Sunflower	lb	2.2
Dry edible bean, field peas, lentil	lb	1.0
Sugarbeet	ton	150
Corn and/or sorghum silage	50 lbs. residue per inch of stubble height per 10,000 plants	
* Potatoes, irrigated	lb	2,300
* Potatoes, dryland	lb	1,400
* If these rates appear high then determine on site. Frequently, low residue due to vine desiccation and harvest traffic.		

Example: A 30 bushel per acre crop of spring wheat produces 3,000 pounds of residue per acre. 30 bushels per acre x 100 pounds = 3,000 pounds.

## HOW MUCH WILL TILLAGE REDUCE RESIDUE?

Crop residue has been generally classified as being either Nonfragile or Fragile as defined in Table 2. This is a subjective classification based on the ease in which crop residue is decomposed by the elements or buried by tillage operations. Plant characteristics such as composition and size of leaves and stems; density of the residue, and relative quantities produced were considered.

Tillage implements vary greatly in how much residue they bury. Table 3 gives a comparison of commonly used implements, and how much residue remains on the surface after each operation. The amount will vary with speed, and depth of the operation. Moisture content of the residue is also a factor. The real impact, however, is the landowner's residue goal.

TABLE 2

Nonfragile		Fragile	
Alfalfa hay	Millet	Canola/Rapeseed	Soybean
Barley	Oats	Dry bean	Sugar beet
Buckwheat	Pasture	Dry peas	Sunflower
Corn	Popcorn	Green peas	Sweet potato
Flax seed	Rye	Lentil	Vegetables
Forage seed	Triticale	Fall seeded cover crops	
Forage silage	Wheat	Mustard	
Grass hay	Sorghum	Potato	
Legume hay	Speltz	Safflower	

TABLE 3

Operation	Percent Residue Remaining	
	Nonfragile	Fragile
Drills - disk type*	80 - 100	10 - 20
- hoe type	50 - 80	40 - 60
Row Planters - Runner openers	85 - 95	80 - 90
- Double disk	85 - 95	75 - 85
Strip Till Planters - fluted coulters	60 - 80	50 - 75
- row cleaning devices	60 - 80	50 - 60
Ridge Till Planters	40 - 60	20 - 40
No Till Planters - smooth coulters	85 - 95	75 - 90
- ripple coulters	75 - 90	70 - 85
- fluted coulters	65 - 85	55 - 80
Rodweeder - without points or shovels	80 - 90	50 - 60
- with points or shovels	70 - 80	60 - 70
Disks - offset and tandem		
- heavy, > 10" spacing	25 - 50	10 - 25
- primary cutting, 9" spacing	30 - 60	20 - 40
- finishing, 7-9" spacing	40 - 70	25 - 40
Chisel Plows - twisted shovel points	50 - 70	30 - 40
- with sweeps	70 - 85	50 - 60
- straight points	60 - 80	40 - 60
Blades, sweeps 20" - 30"	80 - 90	65 - 75
Cultivators - 12" - 20" sweeps	60 - 80	55 - 75
- 6" - 12" shovels or sweeps	35 - 75	50 - 70
Moldboard Plow	0 - 10	0 - 5
Disk Plow	10 - 20	5 - 15
Over-winter weathering - following summer harvest	70 - 90	65 - 85
- following fall harvest	80 - 95	70 - 80
Over-summer weathering	70 - 90	65 - 85

\* Applies to 14" to 18" diameter disk at 4-5 mph. Use lower values for larger diameter and higher speeds.

\*\* The residue reduction factors listed here are but a few of the more common tillage implements used. For a more detailed list of the residue reduction factors contact your local Soil Conservation Service office.

Example: A field with 3,000 lbs. per acre residue. First trip: chisel plow with straight points, 3,000 lbs. x 70% = 2,100 lbs. Second trip: cultivator with 6"-12" shovels, 2,100 lbs. x 75% = 1,575 lbs. Each additional operation would continue to reduce the residue.

## WHAT PERCENT COVER WILL RESIDUE PROVIDE?

Table 4 shows the percent of ground cover that can be expected from various amounts of small grain, corn, grain sorghum, soybean, and sunflower residue.

TABLE 4

Percent Cover			
Pounds Residue	Small Grain	Corn, Grain Sorghum, Soybean, Sunflower Before Tillage	Sunflower After Tillage
200	10%		
400	20%	10%	
600	30%	15%	
800	40%	20%	
1,000	50%	25%	10%
1,500	65%	35%	15%
2,000	75%	40%	20%
2,500	80%	50%	25%
3,000	90%	55%	30%
4,000	85-100%	70%	40%

Example: A small grain field that has 1,000 lbs. per acre residue on the surface has 50% ground cover.

## HOW TO MEASURE PERCENT COVER

Most residue measuring methods are based on representative sites and readings are taken at predetermined points along a knotted string or tape measure. Observe whether or not there is residue at each point. A good way to think of it is to ask, "if a raindrop falls at the point, will it hit residue or bare ground?"

If 100 points are observed, the count of protected points is the percent cover. If 50 points are observed, the count of protected points must be doubled to be expressed as a percent.

The site measured must be typical of the field. Do not measure on headlands, or other places with distorted residue levels. Select a measuring site that runs diagonal to field rows and crosses more than one combine swath. Take a number of

measurements and determine the average. The recommendation is to complete a minimum of 3 measurements with 100 points at each site. Count from only one side of the line. Do not move the line while counting. Count only the residue large enough to intercept rain drops. A rule of thumb is to count only residue that is 3/32 inch or larger in diameter.



Measurement counts being taken with a 50-foot tape.

It is very important that sampling sites be selected at random.

A video on measuring residue is available at the local Soil Conservation Service/soil conservation district office.

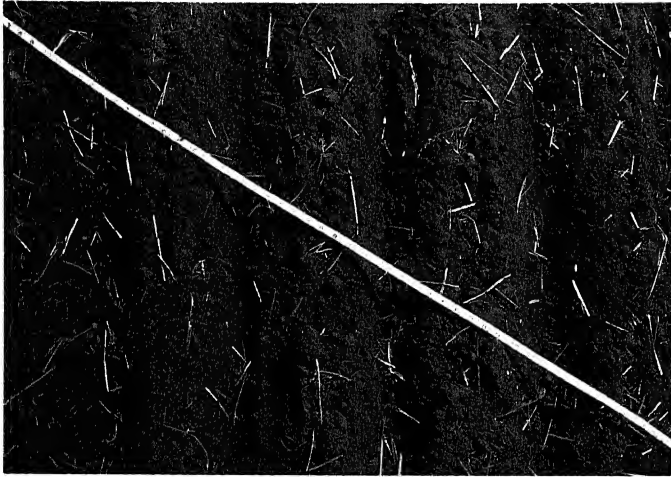


Using the photo comparison method of estimation.

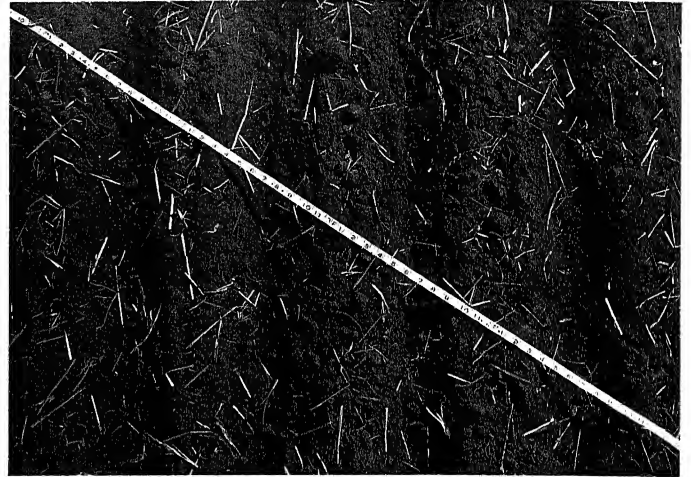
Another  
comparison  
method  
measures  
field  
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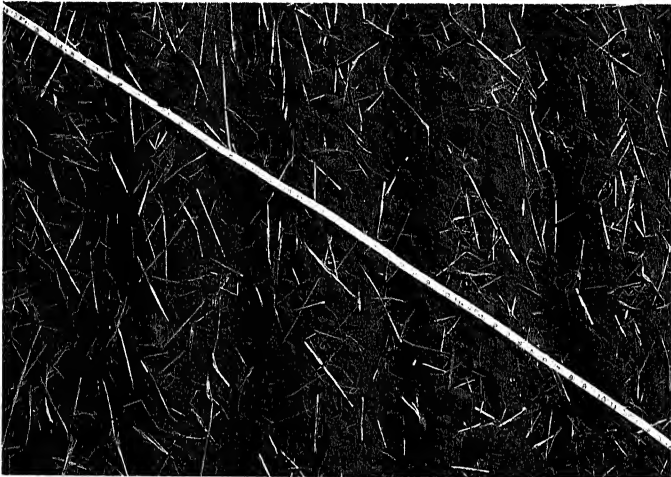
# PERCENT GROUND COVER IN SMALL GRAIN RESIDUE



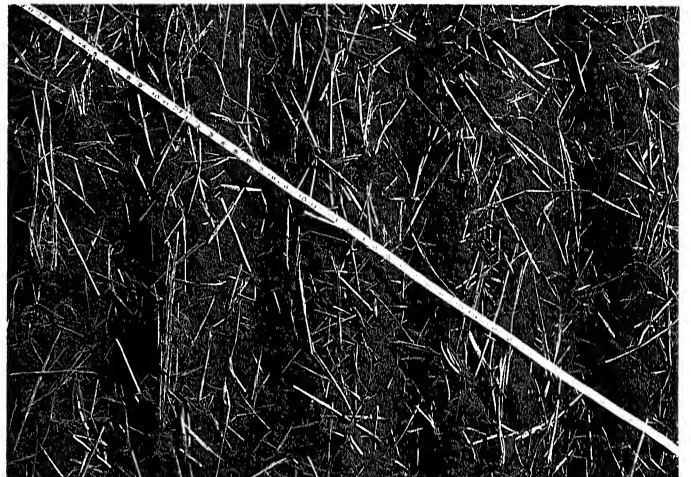
10% -- 200 lbs./acre



20% -- 400 lbs./acre



30% -- 600 lbs./acre



40% -- 800 lbs./acre



50% -- 1,000 lbs./acre



60% -- 1,500 lbs./acre

# PERCENT GROUND COVER IN CORN RESIDUE



10% -- 400 lbs./acre



20% -- 800 lbs./acre



30% -- 1,300 lbs./acre



40% -- 2,000 lbs./acre



50% -- 2,500 lbs./acre



60% -- 3,300 lbs./acre



# PERCENT GROUND COVER IN SUNFLOWER RESIDUE AFTER TILLAGE



10% -- 1,000 lbs./acre



15% -- 1,500 lbs./acre



20% -- 2,000 lbs./acre

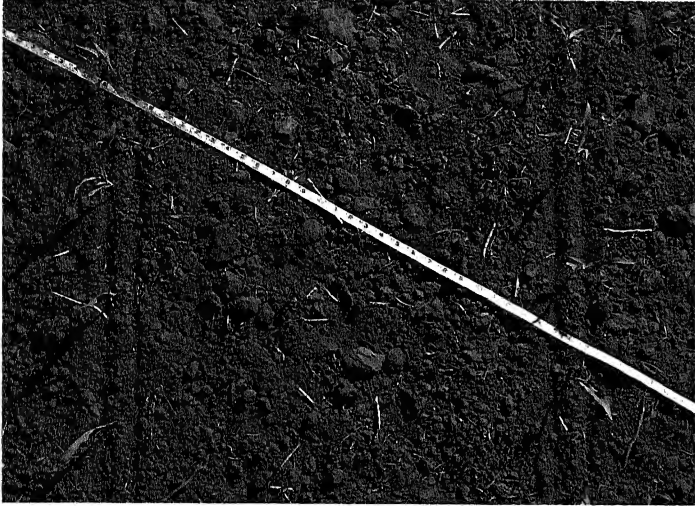


25% -- 2,500 lbs./acre

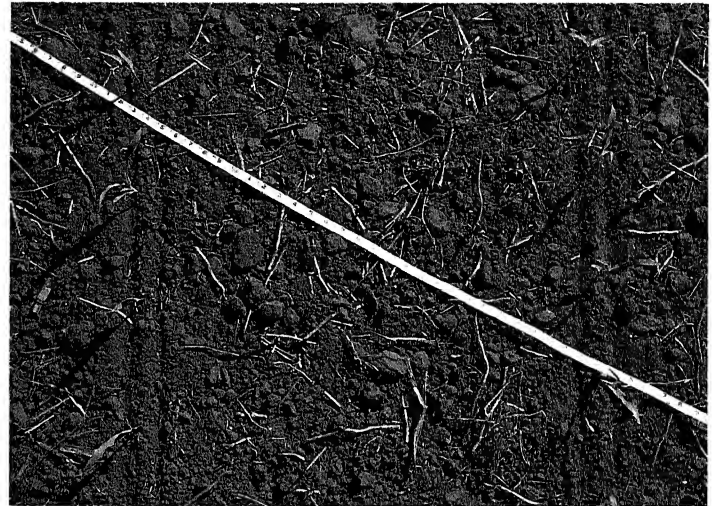


40% -- 4,000 lbs./acre

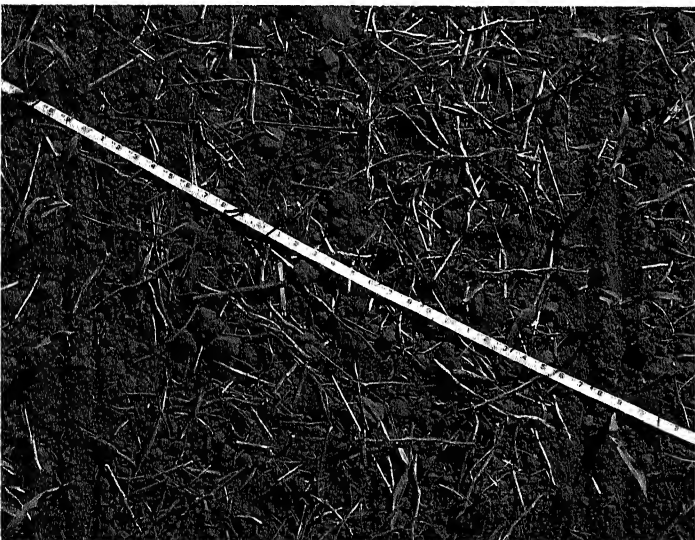
## PERCENT GROUND COVER IN SOYBEAN RESIDUE



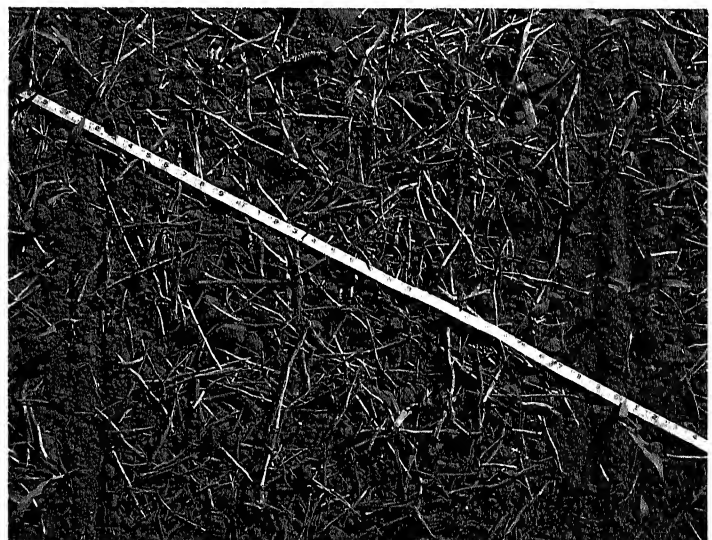
10% -- 1,000 lbs./acre



20% -- 2,000 lbs./acre



30% -- 3,000 lbs./acre



40% -- 4,000 lbs./acre

## Compare Tillage Alone To The Residue Management System

**Crop Residue Goal** 1,000 lbs or 50% ground cover.

Example 1: Wheat going to fallow to be planted back to wheat using tillage alone to achieve a planned surface residue level.

Tillage Alone			Yield <u>25 bu./acre</u>	Yield <u>35 bu./acre</u>
<u>Dates</u>	<u>Operation</u>	<u>Residue Reduction</u>	<u>Remaining residue</u>	
	(Stubble after harvest)	Starting residue	2,500	3,500
	over-winter loss	.20	2,000	2,800
4/15	disk	.50	1,000	1,400
5/10	chisel	.25	750	1,050
6/15	sweep	.10	675	945
6/30	sweep	.10	608	851
7/20	sweep	.10	547	766
8/15	sweep	.10	492	689
	over-summer loss	.20	394	551
	over-winter loss	.20	315	441
Crop residue needed 1,000 lbs. Neither yield met the residue requirement.				

Example 2: Wheat going to fallow to be planted back to wheat using residue management to achieve a planned surface residue level.

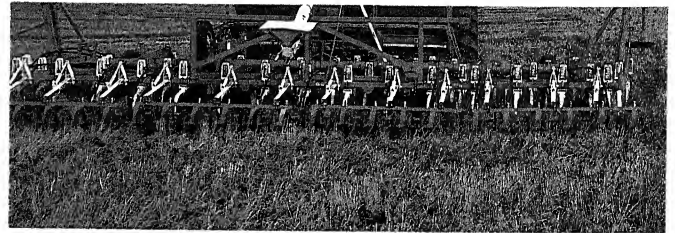
Residue Management System				
		<u>Residue Reduction</u>	Yield <u>25 bu./acre</u>	Yield <u>35 bu./acre</u>
	(after harvest)	Starting residue	2,500	3,500
	loss	.20	2,000	2,800
	control weeds	.00	2,000	2,800
		.10	1,800	2,520
		.10	1,620	2,268
		.10	1,458	2,041
	loss	.20	1,166	1,633
	loss	.20	933	1,306
needed 1,000 lbs. bushel per acre yield met the residue requirement.				

[illegible]



# Crop residue management has many forms ...

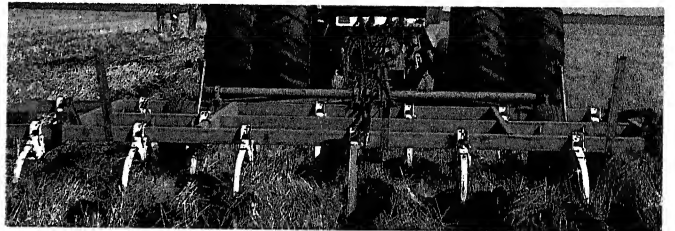
It can be



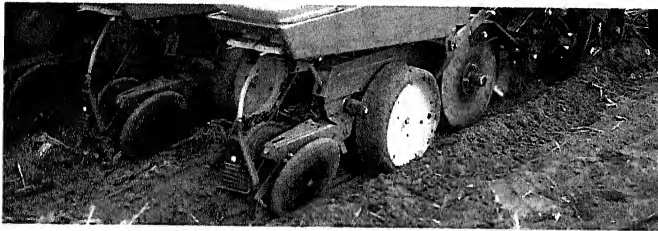
... minimum tillage ...



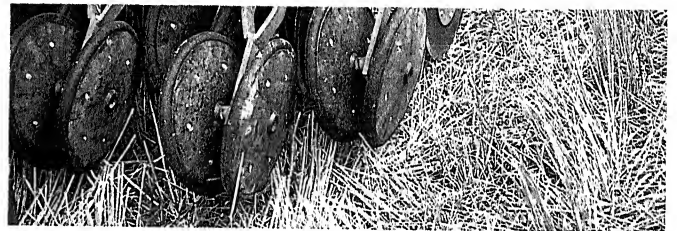
... chemical fallow ...



... stubble mulch ...



... ridge till ...



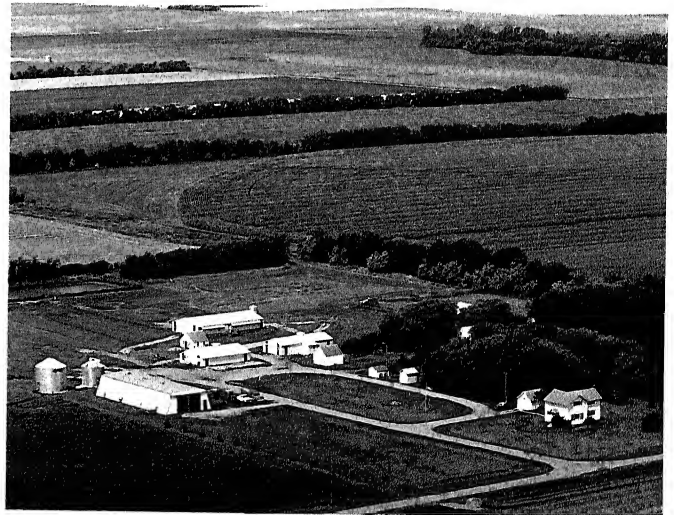
... or no till. Whatever form it comes in, the object of crop residue management is to keep residue on the soil surface.

A sound conservation program usually combines a number of practices which work together. This makes each practice more effective than if used alone.

Crop residue management and conservation tillage systems provide the most benefits when supported by plans which address all the resource concerns on a unit. Other practices will also support residue management such as:

- Field windbreaks
- Stripcropping
- Grassed waterways
- Contouring
- Perennial or annual vegetative barriers
- Diversions and terraces

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